CHAPTER 6

ENVIRONMENTAL POLICIES AND PROCEDURES

When you have read and understood this chapter, you should be able to answer the following learning objectives.

- Explain the basis for the Navy's environmental policies.
- Explain the procedures used in oil spills.
- Explain the methods used for shipboard waste disposal.
- Describe the procedures used in fuel oil storage.
- Explain the use of fuel oil piping systems.
- Explain the procedures used in fueling.

The federal government continues to emphasize how important it is that federal agencies do everything possible to prevent environmental pollution. Presidential executive orders and congressional legislation support this emphasis. All facilities owned by, or leased to, the federal government must be designed, operated, maintained, and monitored to conform to air, water, and noise standards established by federal, state, and local authorities.

The Navy will work to protect and improve the quality of the environment. We will follow all regulatory standards that apply to us, and we will initiate actions to conserve natural resources, protect historical and cultural properties, and prevent or control pollution. This chapter covers the policies and instructions under which we work to protect and improve the environment, and it provides an overview of the procedures we use to do so.

POLLUTION CONTROL LAWS AND REGULATIONS

The following paragraphs offer a brief overview of the more important laws and regulations we use to protect the environment.

In 1899, Congress passed a law prohibiting the discharge of refuse in navigable waters of the United States. The Oil Pollution Act of 1924 prohibits the discharge of oil of any kind (fuel oil, sludge, oily waste, and so forth) into navigable waters. The Oil Pollution Act of 1961 prohibits the discharge of oil or oily mixtures, such as ballast, within the prohibited zones established by any nation, and those zones range from 50 to 150 miles seaward from the nearest land. The 1961 act ratified a 1954 international agreement known as the Convention for the Prevention of Pollution of the Sea by Oil. Proposed amendments would abolish prohibited zones and extend oil dumping prohibitions to all ocean areas.

The Oil Pollution Act of 1924 was repealed by the Water Quality Improvement Act of 1979. This act prohibits the noncasualty discharge of any type of oil from any vessel, onshore facility, or offshore facility into or upon navigable waters of the United States, adjoining shorelines, or waters of the contiguous 12-mile zone. Other features of the act provide for the control of hazardous substances other than oil and for the control of sewage discharges from vessels.

The Clean Air Amendments of 1970 set goals for the reduction of pollutant emissions from stationary sources and vehicles. New stationary sources that burn fossil fuels must conform to emission standards determined by the Environmental Protection Agency (EPA).

In 1970, Congress also passed two acts that declared a national policy to improve the environment. They were the National Environmental Policy Act of 1969 and the Environmental Quality Improvement Act of 1970. These acts require federal, state, and local

governments to create and maintain conditions where man and nature can exist together.

The Navy's environmental quality program is the *Environmental and Natural Resources Program Manual,* OPNAVINST 5090.1. It contains guidelines to prevent, control, and abate air and water pollution. In general, we must ensure that all facilities, including ships, aircraft, shore activities, and vehicles, are designed, operated, and maintained to conform with standards set forth in the 1970 and 1979 acts. The following paragraphs cover the most important requirements of the instruction.

Shore activities will use municipal and regional waste collection and disposal systems whenever possible. We will handle all materials such as solid fuels, petroleum products, and chemicals in ways that prevent or minimize pollution of the air and water. We will reprocess, reclaim, and reuse waste material whenever feasible. Ships will use port disposal facilities for all waste before they get underway and when they return to port. We will not discharge oil products within any prohibited zone, and we will not discharge trash and garbage within 12 miles of shore. We will normally burn waste material in open fires. We will not use sinking agents and dispersants to fight oil spills except when there is a substantial fire hazard or danger to human life.

To meet the requirements of the Clean Air and Water Quality Improvement Acts, the Navy has instituted several ongoing programs. Some of them are in operation and others are being tested and evaluated. For example, we now operate completely enclosed firefighting training facilities from which no smoke escapes. Aboard ship, we have shifted from Navy standard fuel oil to distillate, which reduces air pollution because it has a low sulfur content and burns more cleanly than standard fuel oil. We are now evaluating several models of self-contained shipboard sanitary treatment systems that eliminate the discharge of polluted sewage.

You can see that the Navy is using time, money, and effort to reduce environmental pollution. To support that policy, you should closely supervise all operations that involve fuel handling, waste disposal, and the use and disposal of toxic materials. Indoctrinate personnel on the causes of pollution and the necessity to reduce it. Be sure personnel under your supervision comply with regulations and operating procedures for pollution control devices.

In the rest of this chapter, we'll cover the procedures and facilities we use to help improve the environment.

PREVENTING OIL SPILLS

The preferred method to reduce and control environmental pollution is to prevent the pollution. We must integrate prevention measures into any planned industrial process, operation, or product as part of the cost of daily operations. The following paragraphs discuss ways to prevent pollution caused by oil spills.

Before you start any fueling, defueling, or internal transfer operation, check all machinery and piping systems for tightness and for signs of leaking glands, seals, and gaskets. When you change oil or add oil to machinery, take care not to spill the oil into the bilge. Keep a drip pan and rags ready for use if needed. Keep a close watch on centrifugal purifiers when they are in operation to make sure they do not lose the water seal and dump the oil into the bilge or contaminated oil tank.

When you deballast, keep a careful watch on the overboard discharge to make sure that no oil is pumped overboard with the water from the ballast tanks.

Pump all oily waste from tank cleaning operations into a sludge barge.

Control of shipboard oil pollution is complicated by the many and varied sources of oily waste. The Navy is incorporating oil pollution control systems and components into its ships that will reduce oil pollution by the following means:

1. Reduce the generation of oily waste.
2. Store waste oil and oily waste.
3. Monitor oil and oily waste.
4. Transfer or offload waste oil and oily waste to shore facilities.
5. Process oily waste.

The training officer must ensure that formal training is provided to key personnel who maintain and operate pollution control equipment. The training officer is responsible for training that achieves an acceptable level of expertise.

Figure 6-1 shows a schematic diagram of a typical shipboard oil pollution control system.

As a supervisor, you should be sure that all engineering personnel are familiar with the sources of oil spills and oil waste that may cause pollution. The

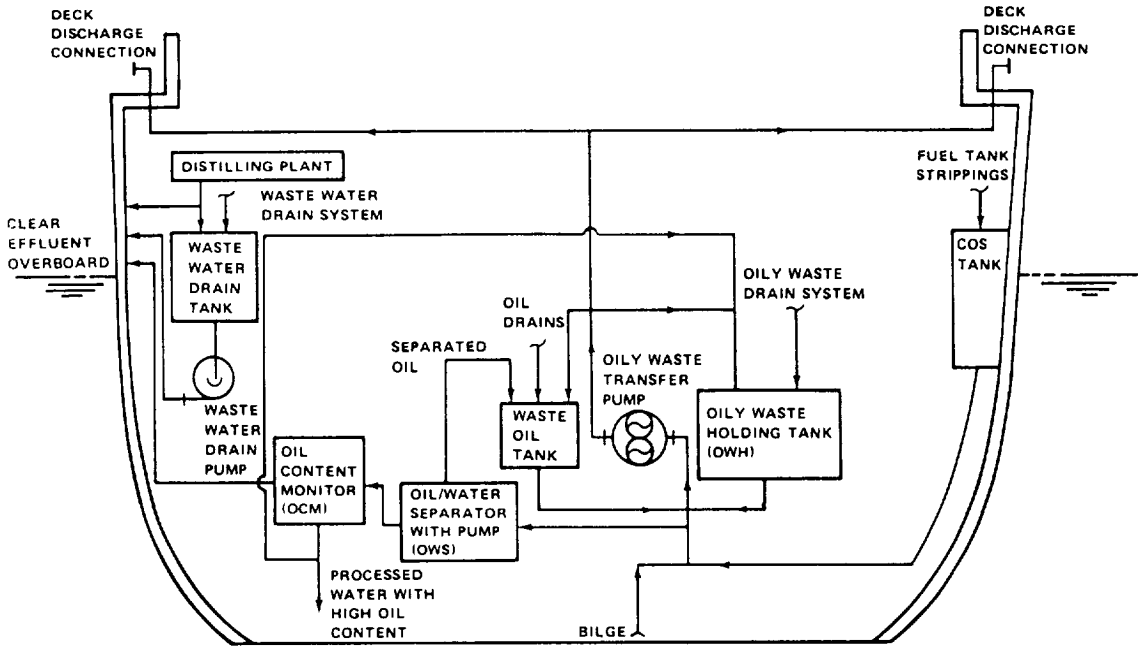

Figure 6-1.-Typical shipboard oil pollution control system.

following lists show common sources of oil and oily waste that find their way into the water.

1. Lubricating oil

a. Leakage and drainage from equipment and systems

b. Contaminated oil from centrifugal purifiers

c. Used oil removed from equipment during an oil change

2. Fuel oil

a. Spillage during fueling, defueling, and internal transfer operations

b. Leakage through hull structures into bilges

c. Stripping from the contaminated oil settling tank

d. Ballast water from fuel tanks of noncompensated fuel systems or bulk carriers

e. Ballast water from compensated fuel tank systems during refueling, defueling, and internal transfer operations

f. Tank cleaning operations

3. Hydraulic fluids

a. Leakage of hydraulic fluid from glands and seals into hydraulic pump room bilges

b. Spillage during system filling or replenishment

c. Spillage caused by hydraulic system casualties

HANDLING OIL SPILLS

All oil spills and slicks or sheens within the 50-mile prohibited zone of the United States shall be reported immediately according to the *Environmental and Natural Resources Program Manual,* OPNAVINST 5090.1. Navy ships can now provide immediate remedial action on oil spills until they are relieved by shore-based response units. Since U.S. shorebased units are seldom available in non-Navy or foreign ports, a ship may have to clean up the entire spill.

A cleanup kit has been developed for use by the ship's crew. The *U.S. Navy Oil Spill Containment and Cleanup Kit,* NAVSEA 0994-LP-013-6010, contains a description of the kit and instructions for its use. The manual describes safety precautions for use of the kit as well as the recommended shipboard allowance. A trained crew that acts quickly can contain a spill, and it can often collect the entire spill without help from shore-based personnel.

SHIPBOARD SEWAGE AND WASTE DISPOSAL

The environmental harm caused by sewage discharges into rivers, harbors, and coastal waters by naval ships is of great concern. Secretary of Defense regulations require the Navy to control sewage discharges. Navy policies and responsibilities are defined in *the Environmental and Natural Resources Program Manual,* OPNAVINST 5090.1.

The Navy intends that all naval ships will be equipped with marine sanitation devices (MSD) that will allow them to comply with the sewage discharge standards without compromising mission capability. However, sewage discharge regulations do not forbid overboard discharge during an emergency when there is danger to the health and safety of personnel. In the past, shipboard sewage has been discharged overboard routinely. We changed that practice when evidence showed that concentrations of sewage in inland waters, ports, harbors, and coastal waters of the United States were bad for the environment.

In 1972 the Chief of Naval Operations decided that the Navy would install the sewage collection, holding, and transfer (CHT) system (a type of MSD) aboard

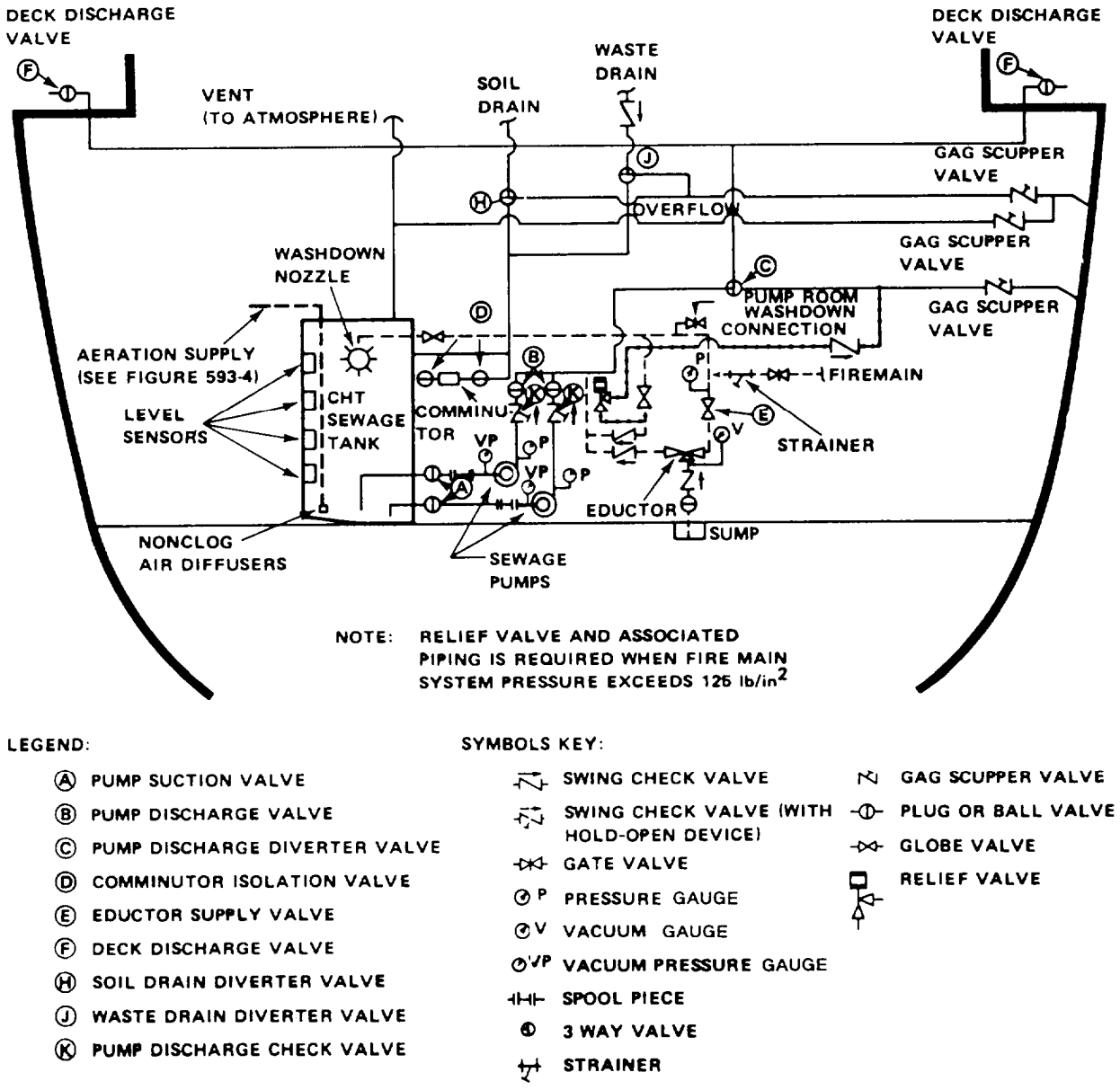

Figure 6-2.-Comminutor-type CHT system.

naval ships that could use that method of sewage pollution control without serious reduction in military capabilities. The CHT system represented the least cost and risk solution to the problem. Most operational fleet ships of sufficient size have CHT systems.

Navy ships have two types of CHT systems. The type for a particular ship depends on the holding tank capacity. Systems with tanks with a capacity of more than 2000 gallons use a comminutor and aeration system. Smaller systems with capacities of less than 2000 gallons use strainers. Figures 6-2 and 6-3 show the comminutor-type and the strainer-type systems.

The goal for the CHT system is to provide the capacity to hold shipboard sewage generated over a 12-hour period. Large ships can usually reach the goal, but smaller ships often reach their capacity in about 3 hours; probably not enough time to get outside the 3-mile restricted zone. Ships can get a waiver if they cannot reach the 12-hour holding time because of serious impact on military or operational characteristics. These ships are identified in DOD Directive 6050-4 of April 1976. Chapter 997 of *Naval Ships' Technical Manual* discusses sewage discharge procedures for ships in drydock.

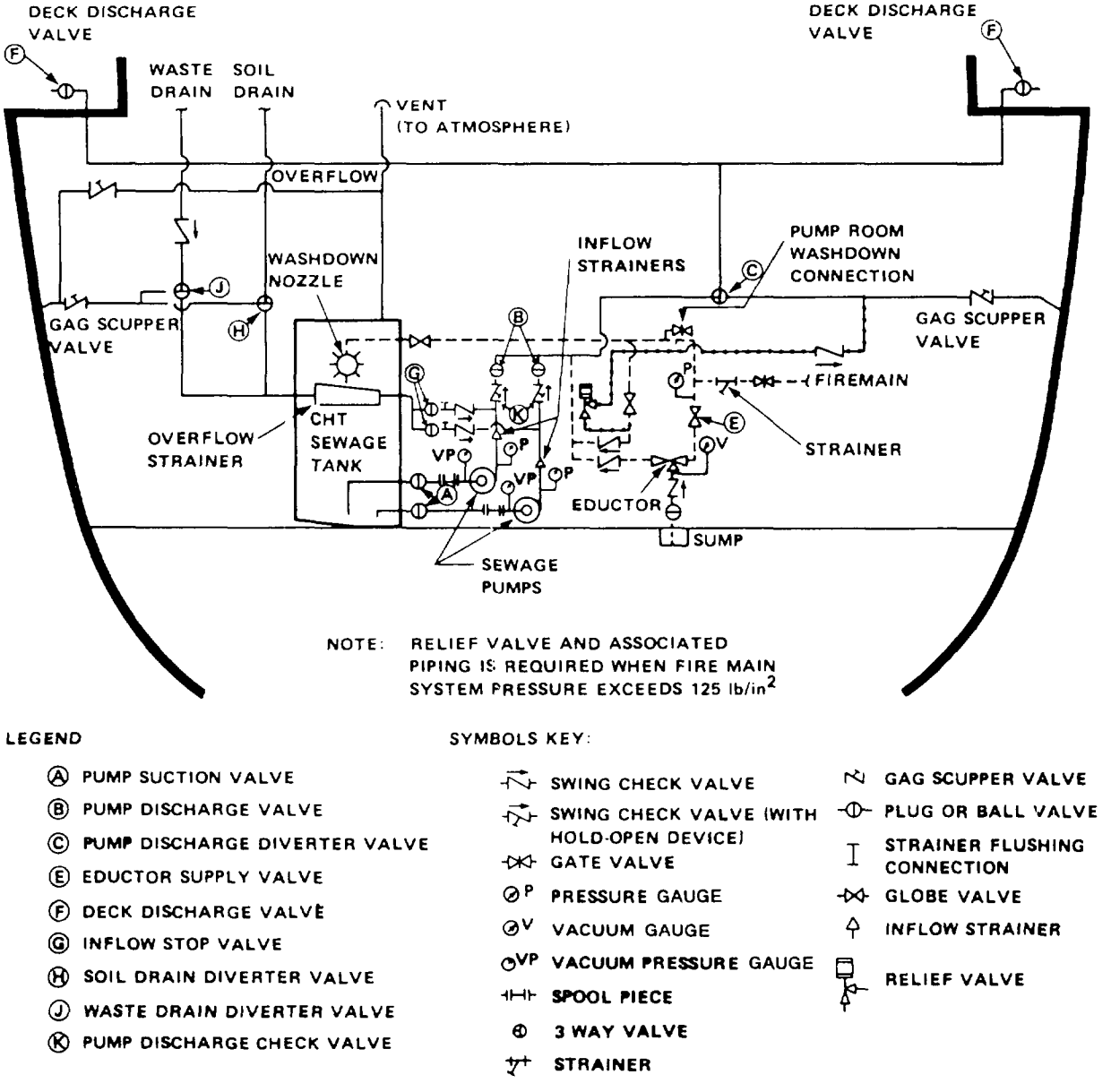

Figure 6-3.–Strainer-type CHT system

The CHT system accepts soil drains from water closets and urinals, and waste drains from showers, laundries, and galleys. The three functional elements of sewage collection, holding, and transfer make up the CHT system.

The collection element consists of soil and waste drains with diverter valves. Depending on the position of the diverter valves, the soil or waste can be diverted overboard or into the CHT tank

The holding element consists of a holding tank. The transfer element includes sewage pumps, overboard and deck discharge piping, and deck discharge fittings.

The CHT system can be used in any of three distinct modes of operation, depending on the situation.

1. When the ship passes through restricted zones, the CHT system is set up to collect and hold the discharges from the soil drains only.

2. During in-port periods, the CHT system will collect, hold, and transfer to a shore sewage facility all discharges from the soil and waste drains.

3. When the ship operates at sea outside restricted areas, the CHT system will be set up to divert discharges from soil and waste drains overboard.

The *Naval Ships' Technical Manual*, chapter 593, has more information on the operation and maintenance of CHT systems.

FUEL OIL STORAGE AND HANDLING

Fuel oil systems aboard ship include fuel oil tanks, fuel oil piping, fuel oil pumps, and the equipment we use to strain, measure, and burn the fuel oil.

FUEL OIL TANKS

Navy ships use four kinds of tanks that are part of the ship's system to receive, hold, and distribute fuel oil. They are (1) storage tanks, (2) overflow tanks, (3) service tanks, and (4) contaminated oil settling tanks. We'll explain their functions in the following pages.

Fuel oil tanks are vented to the atmosphere through pipes leading from the top of each tank to a location abovedecks. The vent pipes allow air to leave or enter the tank as fuel is added or removed. Most fuel oil tanks are equipped with manholes, overflow lines, sounding tubes, liquid level indicators, and lines by which you may fill, empty, and cross-connect the tanks.

Fuel Oil Storage Tanks

The main fuel oil storage tanks are part of the ship's structure. They may be located forward and aft of the machinery spaces or abreast of these spaces. They may be in double-bottom compartments as long as those compartments are not directly under boilers. Some tanks have connections that allow them to be filled with fuel oil or with seawater from the ballasting system.

Fuel Oil Overflow Tanks

Fuel oil overflow tanks receive the overflow from fuel oil storage tanks that are not fitted with independent overboard overflows. Overflow tanks also serve as ballast tanks because they can be filled with seawater from the ballasting system.

Fuel Oil Service Tanks

Fuel oil is taken aboard by fueling trunks or special connections leading to the fuel oil storage tanks. The fuel oil is then pumped to the fuel oil service tanks. All fuel for immediate use is drawn from the service tanks. The fuel oil service tanks are considered part of the fuel oil service system described later in this section.

Contaminated Oil Settling Tanks

The contaminated oil settling tanks hold oil that is contaminated with water or other impurities. After the oil has settled, the unburnable material, such as water and sludge, is pumped out through low suction connections. The burnable oil remaining in the tanks is transferred to a storage tank or a service tank.

The contaminated oil tanks also can receive and store oil, or oily water, until it can be discharged overboard without violation of environmental regulations. See OPNAVINST 5090.1 to learn when you may empty the contaminated oil settling tanks either overboard or to barges.

FUEL OIL PIPING SYSTEM

The fuel oil piping system includes the piping and pumps for three systems, each of which is connected at different levels of the storage or service tanks for (1) the fuel oil filling and transfer system, (2) the fuel oil service system, and (3) the fuel oil tank stripping system. The pipes are connected to the storage and service tanks at different levels so the pumps can take suction from any of these levels. The service system is connected at the highest level, the filling and transfer

system is connected at the next lower level, and the tank stripping system is connected at the lowest level. We'll explain the function of each in the following paragraphs.

Fuel Oil Filling and Transfer System

The fuel oil filling and transfer system receives fuel oil aboard and (1) fills the fuel oil storage tanks, (2) fills the fuel oil service tanks, (3) changes the list of the ship by transferring oil between port tanks and starboard tanks, (4) changes the trim of the ship by transferring oil between forward and after tanks, (5) discharges oil for fueling other ships, and (6) in emergencies, transfers fuel oil directly to the suction side of the fuel oil service pumps.

The fuel oil filling system of some ships consists of a tank-filling and tank-sluicing arrangement. Other ships have pressure filling systems that are connected to the transfer mains so the filling lines and deck connections can be used both to receive and discharge fuel oil. The pressure filling systems operate with a minimum pressure of approximately 40 psi at the deck connections.

In general, the filling and transfer system consists of large mains running fore and aft. These are transfer mains, cross-connections, mains to fuel oil booster and transfer pumps, and risers to take on or discharge fuel oil. Other lines and manifolds are arranged so the fuel oil booster and transfer pumps can transfer oil from one tank to another and, when necessary, deliver fuel oil to the suction side of the fuel oil service pumps.

Fuel Oil Tank Stripping System

The fuel oil tank stripping system can clear the tanks of sludge and water before oil is pumped from these tanks by the fuel oil booster and transfer pumps or by the fuel oil service pumps. The stripping system is connected through manifolds to the bilge pump or, in some ships, to special stripping system pumps. The stripping system discharges the contaminated oil, sludge, and water overboard or to the contaminated oil settling tanks.

Fuel Oil Service System

The fuel oil service system used aboard any ship depends partly on the type of fuel oil burners installed on the boilers. The fuel oil service system includes the fuel oil service tanks, a service main, manifolds, piping, and fuel oil service pumps.

Fuel oil service pumps take suction from the service tanks through independent tailpipes, cutout valves or manifolds, suction mains, and pump connections. The suction arrangements for fuel oil service pumps allow rapid changes in pump suction from one service tank to another. The pump suction piping is arranged to keep to a minimum any contamination that might result if one service pump takes suction from a service tank that is contaminated with water. The tank stripping system is connected through stop-check valves to the service suction mains so these mains can be cleared of oil that is contaminated with water. The service suction main is common to all pumps in one particular space. It has connections to the fuel oil transfer main through stop-check valves that are normally locked in the closed position.

Aboard some ships, JP-5 can be used as boiler fuel in emergencies. The JP-5 systems are arranged so they can discharge to the fuel oil service system.

Two classes of fuel oil service pumps are commonly used: (1) main fuel oil service pumps, and (2) port and cruising fuel oil service pumps. Both are usually screw-type rotary pumps that may be either motor- or turbine-driven, the difference is in size and in gallons delivered.

The fuel oil service system also needs fuel oil strainers, burner lines, and other such items to deliver fuel oil to the boiler fronts at the required pressures.

PRECAUTIONS IN HANDLING FUEL OIL

All petroleum products, including fuel oil, are potentially dangerous. Heated fuel oil may generate vapors that are flammable, explosive, and dangerous if you inhale them. The oil king must have thorough knowledge of these hazards. The oil king also must make certain that all personnel in fuel oil details take the necessary precautions. The following list covers the most important precautions:

1. Do **NOT** allow anyone to smoke or to carry matches or lighters while handling fuel oil.

2. Use only approved types of protected lights when working near fuel oil.

3. Do **NOT** allow oil to accumulate in bilges, voids, and so forth. The vapor from even a small pool of heated fuel oil can cause an explosion.

4. **NEVER** raise the temperature of fuel oil above 120°F in fuel oil tanks. If the tanks are next to a magazine, **NEVER** allow the oil to become hot enough

to raise the magazine's temperature above 100°F, nor to maintain the magazine's temperature at more than 90°F.

5. **NEVER** raise the temperature of the fuel oil above the flashpoint in any part of the system before it enters the boiler.

6. **NEVER** exceed the designed pressure in any part of a fuel oil system.

7. Do **NOT** allow smoking, open flame, or any spark-producing object near fuel oil tank vent pipes.

8. Be sure the wire screen protectors in the vent pipes are intact. Do **NOT** allow the wire screen protectors to be painted.

9. **REMEMBER THAT FUEL OIL FUMES ARE DANGEROUS IF INHALED.** If your eyes sting or burn, you probably also are inhaling the fumes. The symptoms range from headache and dizziness to unconsciousness and suffocation. Give first aid to any person suffering from inhalation of fuel oil fumes; see chapter 3, *Standard First Aid Training Course,* NAVEDTRA 12081. Remember, also, that a person who is suffering only mild effects from inhaling fuel oil fumes may be confused or drowsy enough to cause a serious accident.

10. **NEVER** enter and do **NOT** allow anyone else to enter any fuel oil compartment until the gas free engineer declares it **SAFE FOR PERSONNEL.** Always get permission from the gas free engineer before any person enters a fuel oil tank.

11. Observe all safety precautions for closed or poorly ventilated compartments. These are listed in chapter 074 of the *Naval Ships' Technical Manual.*

12. When the ship is in drydock, be sure oil does NOT drain from the ship onto the dock.

13. Do **NOT** heat distillate fuel by using the ship's fuel oil heaters. In general, you will not need to heat tanks, but severe cold weather may create a need to do so. If the transfer pump is having difficulty moving the fuel, and the fuel in the tank is below 50°F, you may heat fuel oil to approximately 75°F to dissolve the waxy constituents.

14. Use only the sprayer plates recommended for use with the distillate fuel.

15. When burning a distillate fuel, do **NOT** allow a smoky, hazy stack. Improper combustion causes excessive fuel consumption and a dangerous stack condition, and it adds to air pollution.

16. When ships are refueled where the ambient temperature is below 40°F, do not fill storage tanks above 95 percent of capacity. If a tank exceeds that amount, pump the oil down to 95 percent of capacity as soon as possible.

17. Be sure all personnel under your supervision know the provisions of the Oil Pollution Act and the Federal Water Pollution Control Act.

FUELING RESPONSIBILITIES AND PROCEDURES

There are many preparations to be made before the ship actually takes on fuel. The deck force or other personnel are responsible for some of these, but the oil king is responsible for others. For simplicity, this section will be addressed to you, the oil king, though some others will supervise or perform some of the procedures.

Deballast and strip oil tanks as soon as possible after you get word that the ship will take on fuel. If sea conditions make it impossible to deballast before the ship enters port, get permission from port authorities to deballast into a barge after the ship enters port. Be sure the ballasted tanks are pumped out according to the recommended sequence tables so the ship will retain as much stability and maneuverability as possible. We will include more information on ballasting later in this chapter.

Before receiving fuel, order soundings or readings on all fuel oil storage tanks and all fuel oil service tanks. Then, submit a statement to the officer in charge of fueling showing the amount and location of all fuel oil aboard. You always should know how much fuel is aboard, where it is located, how much more can be taken on, and the order in which the tanks should be filled.

Before taking on fuel, see that all service tanks and as many storage tanks as possible are topped off to the 95 percent level. This will reduce the number of tanks that must be filled. This requirement may be modified if it will reduce the time required for fueling; it may be faster to distribute the oil in the receiving ship so approximately the same amount of time will be required to fill at each receiving station. A tank-loading schedule based on previous experience is useful to meet this last requirement.

In some ships, such as destroyers, fuel oil is delivered directly into a fuel oil service tank. When you refuel this type of ship, take fuel oil service suction from

the receiving service tank until just before the approach alongside the delivering ship, then shift suction to a full standby service tank. Never take fuel oil service suction from the service tank that is receiving fuel oil.

Post a fueling watch list well in advance of fueling time, and be sure all personnel involved in the operation know their stations and duties. A fueling detail includes messengers, pneumercator personnel and tank sounders, personnel at the forward and after hose connections, personnel at the manifolds, and telephone talkers. Be sure all fueling detail personnel are experienced and capable.

As a rule, man fueling stations one-half hour before fueling time. Assign only the number of personnel required to handle the fueling. Additional personnel may get in each other's way.

After the fueling stations are manned, but before fueling is started, test the phone circuits, connect the air hoses to the fueling connections, and screw thermometers and pressure gauges into the fueling connections if they are required.

Before starting fueling, check equipment at all stations. Equipment required for fuel tank sounding stations includes graduated sounding rods or tapes (if used), rags, and tee wrenches. Equipment required for topside fueling stations (depending on the type of refueling rig used) includes sledge hammers, axes, ball peen hammers, bolt cutters, hose coupling spanner wrenches, rags, and end fittings.

When fuel oil is received from a naval source of supply such as a naval ship, a naval storage tank, or a naval fuel barge, the activity supplying the oil must furnish the commanding officer of the receiving ship with an analysis of the oil. If possible, you and an officer of the receiving ship should witness soundings and the drawing of samples from the tanks of the supplying activity. The samples must be taken from the suction level of the tank from which the oil is to be drawn. One sample should be taken before the unloading is started, and another after the loading is completed. Both samples must be centrifuged to determine the percentage of sediment and water.

When fueling is done at sea, it may be impossible for the delivery ship to furnish a complete analysis of the oil and for the receiving ship to send representatives to witness the soundings and samplings. In this case, the supplying vessel furnishes a statement of the American Petroleum Institute (API) gravity and water and sediment content of the oil. The receiving ship must then take samples during delivery and make tests to determine the percentage of water and sediment. Take the samples with a dipper from the tank that is being filled, or draw them through connections in the delivery pipeline. Take enough small samples to make a total sample of at least 5 gallons. Then, take smaller samples from the total sample for the test. Before you take the samples, clean all the containers you will use for that purpose.

When fuel is coming aboard, keep a constant check on all tanks that are receiving fuel. In large ships, in particular, you must follow a systematic procedure to get all tanks properly filled without unnecessary loss of time. You also must be sure the stability of the ship is not impaired.

When there are several tanks in each overflow group, initially open one or two tanks in each group. When these have been filled to approximately 85 percent capacity, start filling the others in the group and closing down the valves to the tanks that are almost full, topping them off slowly. Fill the overflow tank in each group last.

Each tank has a sounding rod or a tank-capacity indicator of the pneumercator type. There may be other systems in use, which will not be covered, but you can get information about them from the manufacturer's technical manual. As oil is being received, assign someone to each tank that is receiving fuel. If you are using a sounding rod, sound the tank every 3 or 4 minutes until it is nearly three-fourths full. From this point on, take continuous soundings. Fill tanks to the 95 percent level You can fill to slightly above this mark to allow the oil to foam, but be sure the **FINAL** level of oil in any tank is at the 95 percent mark.

As each succeeding tank is filled, be sure personnel at the remaining tank sounding stations are even more alert than before. As the last tank is being filled, notify the delivery ship to drop the pump pressure or to slow down the pump, as appropriate.

After you have determined the amount of fuel oil being received per minute, you can give the delivery ship a "stop pumping" time. If your calculations are correct, all tanks will be full when the pump is stopped.

You must keep the fueling officer informed as to the amount of oil received as a percentage of the total to be received and the probable time required to complete the fueling. The fueling officer keeps the commanding officer posted on the progress of the fueling.

When all tanks are full, empty the fuel hose by one of two methods: (1) blow back the oil in the hose to the

delivery ship by opening the compressed air valve to the fueling connection, or (2) have the supplying ship take a back suction, which also requires that the air valve be opened. As soon as the fuel hose has been cleared, **IMMEDIATELY** uncouple the hose and return it to the delivery ship.

You also must be familiar with the procedures used to discharge fuel. The following list shows some of the steps typically used to discharge fuel oil:

1. Be sure the tanks from which fuel is to be discharged are filled and topped off to the 95 percent level.

2. If necessary, heat the oil to the temperature required to produce a viscosity of 450 SSU. This procedure is not usually required with distillate fuel.

3. Sound all tanks that will be used.

4. Couple the fuel hose and rig it according to prescribed procedures.

5. Line up the fuel oil system to discharge fuel, and test the operation of the fuel oil pumps.

6. Place red flags over the side of the ship at the fueling stations.

7. Be sure the officer of the deck has draft readings taken forward and aft before and after fueling.

8. Set the fueling detail, setup the fueling board, and fill in available data on the fueling sheet for the fueling officer.

9. Man fueling stations about one-half hour before the expected time of approach of the ship to be fueled. Be sure personnel at the fueling stations test sound-powered phone circuits, connect air hoses to the fueling connections, screw in thermometers and pressure gauges, warm up the fuel pumps, and open valves to the fuel tanks. When the fueling detail is ready and has made all required checks and preparations, report to the fueling officer. The fueling officer will inform the bridge and request that the smoking lamp be out.

10. When you get word to start discharging fuel, start the pumps and operate them slowly at first, then bring them up to full-rated capacity. Bui!d up a pressure of approximately 40 psi at the fueling connections.

11. Continue pumping at the rated pump capacity until a tank is down to approximately 35 percent of its capacity; then shift pump suction to another tank. Slow the pumps and stop them upon a request from the receiving ship,

12. Remove fuel oil from the fuel hose by blowing air through it, or the delivery ship may take a back suction. Disconnect the hose and rig and handle them according to prescribed procedures.

13. Sound the tanks and compute the amount of fuel discharged.

BALLASTING SYSTEM

Whenever a liquid is shifted from one place to another aboard ship, there is an effect on the ship's list, trim, or stability. One of your routine jobs is to reduce any instability. To do that, you should keep as many fuel oil tanks as possible filled with fuel oil to the 95 percent level. There may be other times when you may have to use the ballasting system to move seawater to or from empty tanks. Normally, you will need to do that only in case of damage or when the ship has an unusually small store of fuel oil that brings on instability.

To keep the fuel oil tanks at 95 percent capacity, you should accumulate leftover fuel oil from partly used tanks so only those tanks actually in use are less than 95 percent full. This prevents free surface effect that occurs when a liquid only partly fills a tank and moves freely back and forth as the ship moves. There is some free surface effect when a tank is filled to the 95 percent level, but the effect is limited because the overhead interferes with the free movement of the liquid beyond a certain point. There is more danger of serious loss of stability from tanks that are half-full than from tanks that are 95 percent full.

The ballasting system allows controlled flooding of certain designated tanks to control the ship's stability. You can use the ballasting system to flood all tanks that are designated as fuel oil and ballast tanks and to flood certain voids. The ballasting and deballasting systems are arranged so all designated compartments and tanks can be ballasted either separately or together and drained either separately or together. Seawater is used as ballast, and it may be taken from the firemain or directly from sea chests. Use drainage pumps or eductors to remove the ballast water. Handle all ballasting and deballasting according to the sequence tables furnished for each ship or class of ship.

Ballasting empty fuel oil tanks helps control stability by maintaining a low center of gravity in the ship and by keeping off-center tanks full to prevent off-center flooding. Ballasting also contributes to torpedo protection—it provides a layer of nonflammable liquid at the shell of the ship to absorb fragments and otherwise minimize torpedo damage.

Admit ballast water only to those tanks that are designated for ballasting. Be sure the tanks are empty of fuel oil before you add ballast. After you have used water ballast in any tank, remove as much water as possible before you fill it with fuel oil. Use the lower level suction lines for that purpose.

If your ship suffers collision or battle damage, the damage control aspects of the your job may suddenly become vital. To make stability calculations, damage control central must have accurate information on the distribution of all liquids carried on board. To maintain or improve stability, they may order the immediate transfer of fuel oil, feedwater, or other liquids. If you are the oil king during such an emergency, you will not have time to learn your job or to catch up on details you may have forgotten or overlooked. You must **ALWAYS** know how much liquid is in all tanks and exactly how the fuel oil or feedwater transfer systems must be lined up to shift liquids from tank to tank.